Track B – Session 3: Non-Traditional Data Sources

Innovative Data Collection Techniques: An Analysis of Probe Vehicle Technologies

Mike Akridge

While available traffic-monitoring infrastructure has the capacity to provide much of the data necessary to support the Florida Department of Transportation's (FDOT) traffic management and traveler information needs, gaps persists with regard to geographic coverage, accuracy, and dependability. Based on what has been learned about probe-oriented traffic data collection solutions, it is widely believed that significant opportunities may exist for these technologies to cost effectively complement, and in some cases replace, traditional traffic data collection resources. With this in mind, this presentation will report on research carried out on behalf of, and a field test utilizing toll transponders underway by the Florida Department of Transportation (FDOT) concerning the potential for utilizing a variety of innovation, probe-oriented traffic data collection technologies to enhance the accuracy, timeliness, and reliability of real-time traffic data.

Although toll transponder-based traffic data collection systems have been utilized as the basis for regional ATIS and performance monitoring systems in other parts of the United States, the project currently being undertaken by the Florida Department of Transportation (FDOT) differs in that FDOT's plan calls for the evaluation of transponder penetrations across the entire state, aimed at developing mega-regional or statewide transponder-based traffic data collection systems. Such systems would supply travelers and fleets with improved real-time data on intercity, multi-jurisdictional traffic conditions (thereby facilitating route choice [tolled vs. non-tolled] decision-making among motorists), as well as provide FDOT with a supplemental mechanism to support its existing mobility performance measures program.

Track C - Session 4: Estimation of Truck Traffic Volumes

Modeling and Predicting Heavy Truck Movements at Seaports

Haitham M. Al-Deek

Truck trip generation models will provide transportation planners and public agencies with valuable information necessary for prioritizing funds for roadway upgrade projects and port infrastructure modifications to improve land access to seaports. This paper presents a multi-phase study conducted by the University of Central Florida's Transportation Systems Institute (UCF-TSI) to forecast inbound and outbound heavy truck movements at Florida seaports and transportation networks surrounding them. A new method has been developed by UCF-TSI to predict truck traffic and has been applied successfully at six major Florida seaports including Miami, Tampa, Palm Beach, Jacksonville, Everglades, and Canaveral.

Track B – Session 7: Integration of Data Sources

Data Integration for Asset Management - US Perspectives

Roemer Alfelor

This presentation will discuss the principal concepts and framework for Transportation Asset Management and the requirements for data integration in supporting Asset Management processes. A general description of data integration initiatives in State transportation agencies throughout the US will be provided, as well as the ongoing efforts by the FHWA to assist in implementation.

Track B – Session 6: Remote Sensing

Truck Traffic Analysis Using IKONOS Satellite Imagery

Delmar E. "Andy" Anderson

Space Imaging has conducted a preliminary evaluation of the use of one-meter resolution IKONOS satellite imagery to analyze truck traffic. In the Interstate 25 corridor of Denver, Colorado, the analysis focused on identifying vehicles, quantifying the flow rate as a function of vehicle density and speed, and classifying vehicles (passenger, semi-trucks, etc.). Special emphasis was placed on identifying and quantifying the number of trucks greater than 60 feet in length. The volume of trucks of this dimension is a good indicator of interstate truck traffic for major highway corridors. The hourly flow rate based on the exploitation of the IKONOS imagery for a 5.9-mile section of Interstate 25 was derived. This value was then compared with traditional sources of traffic data collected with ground-based counters to help validate the methodology. Preliminary results indicate that the technique provides results within 10% of actual counts. Key Words: Traffic flow, traffic counts, high-resolution satellite imagery.

Track A – Session 2: Traditional Sensors

WIM Site Selection.

Michael Ashbrook

This presentation will address the criteria that NCDOT uses in the selection of WIM site locations. This will include the pavement conditions at the prospective site, traffic conditions, safety of both NCDOT personnel and equipment, availability of telemetry, and calibration concerns. Each area will be discussed in relation to how the criteria are applied in choosing a location for a new WIM site.

Track A – Session 4: Data Archiving

California's Integrated Transportation System Network (TSN)

Joe Avis

Caltrans developed the Transportation System Network to hold core information about California's highway system and inventory. The system was built using Oracle Transportation Manager (OTM) plus extensions to replace the functionality of four legacy systems.

- Traffic Accident Surveillance and Analysis System (TASAS)
- Traffic Volumes
- Highway Performance Monitoring System (HPMS)
- Pavement Management System

Caltrans took on the ambitious step of developing the Transportation System Network (TSN) to satisfy the need for an information system that would reduce data redundancy; provide more open, flexible, and modern IT setup for users to maintain and access information from a centralized data repository.

This presentation will highlight the development and implementation process of TSN. Lessons learned, both positive and negative will be addressed with emphasis on the Traffic Volumes portion.

Poster Session

Sensor Sharing

Joe Avis

This poster will illustrate with photographs the use of a device to allow Automatic Traffic Recorders (ATRs) that detect electronic switch closures to safely read the outputs of detectors installed in traffic signals, ramp meters and Traffic Management Center applications.

Track C – Session 4: Estimation of Truck Traffic Volumes

The Development of a Freight Truck Travel Demand Model for Florida Innovative Data Collection Techniques: An Analysis of Probe Vehicle Technologies

Daniel F. Beagan

This presentation describes a project conducted for the Florida Department of Transportation (FDOT) to develop freight and goods movement analysis tools at the statewide level. An objective of the project was to develop a freight truck model that could follow and be integrated with the four-step travel demand models commonly used in statewide passenger modeling.

The study used the 1998 TRANSEARCH™ commodity flow database to develop coefficients for trip generation, trip distribution, mode split and highway assignment components. The freight model utilizes the same zone structure, socioeconomic variables and highway network for Florida as the existing statewide passenger model. Reflecting the national influence of freight, this information was expanded to a zone structure and network covering the continental United Sates. Using the information in the freight database, it was found that freight movements could be easily explained by the four-step process.

It was also found that the model would need to be supplemented in urban areas with truck models that forecast the movement of service, delivery, construction, and other trucks not considered in the commodity flow data. This presentation shows that a freight model can be successfully developed to produce intercity highway truck volumes consistent with observed truck counts, that successfully explains long-distance freight truck movement, and that can be used in developing freight plans and programs.

Track C – Session 11: Innovative Uses and Applications of ITS/Operations Data Archives

Monitoring Mobility: Utilizing Environmental, Weather, and Traffic Data

Robert J. Benz

The Houston area is often impacted by unpredictable severe weather events, such as heavy rains, winds, and sometimes ice which can cause many area roadways to quickly become impassable, devastating mobility in the region. An area-wide environmental monitoring system, containing 27 station locations was deployed to provide real-time information on roadway water depth, rainfall rate, humidity, wind speed, wind direction, air temperature, pavement temperature, pavement moisture, and stream velocity to the local traffic management center Houston TranStar.

The environmental monitoring system data will be stored in a data warehouse along with traffic loop (volume, speed, and occupancy) and Automatic Vehicle Identification (AVI) data. The environmental and traffic information will allow traffic engineers to quantify the effects of environmental or storm events on traffic operations. Historic trends on rain intensity and its effect on roadway flooding allows operations personnel to better predict roadway flooding and taking action to reroute emergency and transit vehicles, as well as, the traveling public saving time, money and lives.

Future data sources such as site emissions (NOx, CO, etc.), incident, and accident information will provide other opportunities to better quantify the interrelationships between incidents, traffic, and emissions. In addition to these unique research activities a variety of pre-defined tables and graphs along with user-defined queries allow operations, planners and hydraulics personal to assess plans and procedures to improve the operations and design of the transportation system.

Track C – Session 2: Congestion Management Systems: The Role of Travel and Traffic Data

Wilmington MPO

Dan Blevins

One of the remaining management system requirements is that major metropolitan areas develop Congestion Management Systems. These systems must identify and evaluate congestion, and select mitigation strategies, based on system wide analysis. In addition, congestion relief strategies must be selected that emphasize operational and demand management strategies in favor of, or in coordination with, new highway capacity.

The CMS provides a level of analysis on a regional scale, but can also guide additional studies that may be required at the subarea, corridor, or project level. This provides an important link between regional and subregional planning efforts and ensures that the policies to guide strategy selection are maintained throughout the process. In addition, a well-designed CMS can eliminate duplication of effort and support later MIS or NEPA planning work to streamline the planning effort.

The CMS is an integrated part of the metropolitan planning process, but congestion mitigation must be considered in a larger context and with consideration given to other planning factors.

WILMAPCO developed a four-step CMS process that included system identification, congestion identification, strategy evaluation, and system monitoring. The CMS was also developed through a strong interagency effort, including the input of planning and project development staff at member implementing agencies, who have the responsibility to use the CMS products to guide further planning and project development efforts. While additional work is required, the WILMAPCO CMS will support planning work and influence policy debate regarding transportation investment priorities and regional quality of life goals.

Track C – Session 7: ITS Archived Data – Now and the Future

ARTIMIS Archived Data Partnership: the Kentucky Transportation Cabinet and the Ohio Transportation Department

Rob Bostrom

Establishing an Archived Data System is a complex endeavor due to the breadth of the data, the number of stakeholders, and the lack of established guidelines. The Kentucky Transportation Cabinet, the Ohio Transportation Department, and others have successfully established an Archived Data System for ARTIMIS – an advanced traffic management system in the metropolitan area of Cincinnati. The presentation will discuss the history of the data archiving, the data products, the sensors and data quality, the involvement with the FHWA's Mobility Monitoring Project, the development of new software and new data formats, coordination with ASTM's archived data standardization process and possible directions in the future.

Poster Session

First National Conference/Workshop on Automating Data Collection for Transportation Planning – November 6-7, 1974

Mulder Brown

A presentation from the proceedings that looks back in time to this conference's origins.

Track B – Session 2: Privatizing Traffic Monitoring Programs

Amortized Performance Based Outcome WIM System Management

Dayton Burlarley-Hyland

VMS, Inc., a total highway asset management contractor has entered into a multi-year agreement to maintain/manage various roads and streets in the District of Colombia (DC). This privatized total highway asset maintenance contract includes the District's WIM sites.

VMS in turn issued an RFP for the reconstruction and maintenance for the DC WIM sites. The RFP resulted in an innovative contract, which can be adapted for use by governmental agencies, that includes the distribution of payment for all construction/reconstruction of the WIM sites over the four year (in this case) contract with quarterly payments tied to the performance outcomes identified in the contract.

The quarterly payment, for construction/reconstruction and maintenance, is diminished (or eliminated) by a sliding scale, which is dependent on the number of days within a given quarter that the system does not provide acceptable data or is inoperable. A provision is also included for a reduced quarterly payment if any necessary repairs are not completed within the time defined in the contract.

Utilizing this type of full service, multi year contract with performance based outcomes and costs amortized over the length of the contract would result in an increased number of WIM sites with data guaranteed to meet performance standards and a lower upfront outlay of capital funds.

Track A -- Session 8: Automatic Traffic Recorder Fundamentals

Digital Pagers for Telemetry

Jim Cerqua

Purpose/Problem/Issue

One of the most important considerations, from an operational standpoint, of a permanent traffic monitoring site include data retrieval issues. Options available include site visit and telemetry. Having a large number of sites to visit, or spread over a large geographic area, the first method becomes resource intensive. With this in mind, telemetry has become an accepted practice in the industry.

The current practice revolves around a modem and a telephone connection. This connection could be either landline or cellular based. Average charges can run around $30.00 per month for telephone service. A cost effective alternative is the use of two-way digital pagers.

Methodology

The principal of using digital paging for data retrieval is similar to email. Traffic data is sent to an internet server where it resides until downloaded.

Conclusions

Digital paging technology, when used for traffic data retrieval, is a workable solution. It is useful in areas of cellular congestion or where there is limited service. It can lower the communication costs associated with a traffic monitoring site.

Track C – Session 11: Innovative Uses and Applications of ITS/Operations Data Archives

Estimating Temporary Loss of Capacity Due to Incidents, Work Zones and Crashes

Shih-Miao Chin and Ho-Ling Hwang

Work is being performed for FHWA to estimate the temporary loss of capacity due to incidents, work zones and crashes. For a selected set of metropolitan areas, archived data from their traffic management centers is being used to factor AADT estimates from the Highway Performance Monitoring System (HPMS) to estimate the temporal profiles of the use and capacity of roadway facilities. That is then contrasted to observed archived data of system use when various known incident, work zone, and crash events occurred so as to calculate the temporary loss in the use and capacity of the roadway system in the vicinity of the events.

Track C – Session 12: GIS and Web Tools to Organize Urban Traffic Data

Visualizing Urban Traffic Data

Shih-Miao Chin and Ho-Ling Hwang

With the increasing travel demand, urban traffic congestion and associated environmental impacts have become major factors that could inhibit future economic growth and social progress. Recently, a number of large cities have employed Intelligent Transportation System (ITS) methods to provide real-time information to their residents regarding traffic congestion. Many provide this information via web sites that are regularly updated. Others distribute real-time traffic data to their citizens via radio, television, or electronic bulletin board. The data provided may include vehicle speed, flow rate (i.e., vehicles per hour), travel time, incident reports, and road construction information. Although massive volumes of ITS data are collected each day, only relatively rudimentary data are generally disseminated to the general public at the present time. Traffic pattern visualization using Geographic Information Systems (GIS) is one area that can truly benefit from such massive volumes of real-time traffic data.

This paper reviews existing GIS applications and web sites for urban traffic congestion and incident information presentation. Furthermore, it shares Oak Ridge National Laboratory's experience from a previously developed traffic patterns visualization system. This system utilized computer-generated time-lapse animations to show changes over time for traffic congestion patterns, over an area network and along a corridor. Lessons learned and some of the problems encountered are also presented.

Track A – Session 6: Quality Control of Data

Quality Control for short-term Daily Counts

Susan Cosper

Purpose/Problem/Issue:
Short-term daily counts comprise most of the North Carolina Department of Transportation's extensive Coverage Count program. The current process uses mainframe programs with extensive manual editing and subjective analysis to process 34,000 counts annually. Absent from this process are statistical measures of quality. In addition, the time between counts collected and the actual analysis process can be lengthy, diminishing the window of opportunity to investigate counts that appear anomalous. This in turn increases the number of recounts taken for verification purposes.

Methodology:
A quality control process was designed to eliminate or control known sources of variation and improve efficiency in time and manpower. Through the development of desktop computer programs, many of the tasks associated with manual edits and analysis of the data are automated. Control chart methodology and spatial analysis, which is currently under research, provides statistical measures of quality and a basis for accepting or rejecting count data. The process also requires replacing existing microstation databases with geodatabases and current GIS technology in order to facilitate the spatial analysis, automate manual updating, posting, and publication of maps in both hard copy and CD formats. The time between data collection and processing can be completed within two months, versus a year, which reduces subjective estimation and recounts.

Conclusions:
This presentation will highlight the benefits associated with the development and implementation of a quality control process in a transportation environment.

Poster Session

Data Processing Using Graphics in Microsoft Access

Michael S. Curley

How NHDOT uses Microsoft Access to graph and chart the hourly data for the monthly traffic data. Presenting the data visually helps pick out erroneous data that may be missed otherwise. The applications were developed in-house by staff in the Traffic Research section.

Track A – Session 11: Weigh In Motion

A Process to Calibrate a WIM System, Monitor that Calibration and Determine the Validity of the Weight Data

Curtis Dahlin

The process of calibrating a WIM system, monitoring that calibration over time and then determining the validity of the data collected by the system is not a simple undertaking. Some of the processes proposed here are currently being used while others are not widely used.

A loaded 5 axle semi should be used to calibrate the system. The distribution of gross weight of traffic stream 5 axle semis should then be examined to determine if the peak for the loaded trucks is in the expected location. If it is not, one needs to decide whether or not to adjust the calibration. The distribution of gross weight should then be monitored over time to determine if the calibration remains correct.

In addition, the standard deviation of the weight of the front axles of 5 axle semis should be monitored. A low standard deviation, eg. 10%, indicates the system is working well and that there is minimal variability in the weights. A high standard deviation, eg. 20 %, indicates a high amount of variability.

It is necessary to use several procedures together in order to most fully understand how the system is performing in regards to calibration and the validity of weight data.

Joint Track -- Session 5: ITS/Data General Session

Mining of Florida ITS Data for Transportation Planning

Harshad Desai and Chester Chandler

Purpose and Scope

The Florida Department of Transportation has been actively involved in implementing Intelligent Transportation Systems (ITS) strategies to improve safety and efficiency of travel in urban transportation networks. Consequently, several Advanced Traffic Management Systems (ATMS) have been created for the purposes of monitoring and managing traffic on freeways through real time and area wide surveillance that facilitate rapid incident detection and clearance.

The sensors used for freeway surveillance include inductive loop detectors and non-intrusive detection systems such as video imaging detection (VID). The FDOT Transportation Statistics Office, which is responsible for collecting and disseminating traffic data realized the potential of mining the ITS data to augment data collected by temporary and permanent count stations distributed throughout the Florida highway system.

The FDOT Transportation Statistics Office commissioned a study to determine whether the ITS data can be mined in the form suitable for transportation planning purposes. The study conducted by the FAMU-FSU College of Engineering, focused on Orlando ATMS that currently encompasses thirty-nine miles of Interstate 4 corridor in Orlando metropolitan area. There are two loops installed in each lane in both directions and are spaced approximately ½-mile. The loops are polled every 20 seconds and the volume, speed, and occupancy data collected are aggregated in 60-second intervals.

Status of the Project

The FAMU-FSU College of Engineering research team is currently working with the Orlando Traffic Management Center to determine the best way of accessing the database that contains traffic data collected at various loop detector stations on I-4. Specifically, the research team is currently evaluating the following:

(a) direct access of the data through the Orlando TMC server using the IP address provided by the Orlando TMC. Initial review of this process indicates that the data is displayed in html format that makes it difficult to download and manipulate the data using Oracle SQL routines. A solution to this problem is being sought.

(b) the use of data already collected by the University of Central Florida. The UCF team has saved data on a CD and sent it to the FAMU-FSU team this week. Preliminary analysis of these data indicates that they are not a complete 24-hr data and are in a format that will be difficult to manipulate. It might be impossible to use this data to achieve the goals of the project.

The FAMU-FSU College of Engineering team is in the process of resolving these issues with the Orlando TMC and UCF personnel. In addition, the FAMU-FSU College of Engineering team is working on a long-term plan that would simplify conversion of ATMS data for planning purposes. A robust computer routine will be developed and installed at Orlando TMC to facilitate web-display of traffic information. This task will be accomplished as part of the "Data Warehousing" project to be undertaken by the University of Central Florida.

Track C – Session 8: Monitoring for North American Cross Border Traffic

Data on Trucks Flows Across the U.S.-Canada Border

Rick Donnelly

The recent Canadian Roadside Study collected detailed data on truck movements between the U.S. and Canada. The data, now available to transportation agencies on both sides of the border, are more detailed than previously available. This presentation will discuss how these data can be used to evaluate cross-border traffic patterns, and how they can be coupled with other data to form a complete picture of U.S.-Canada truck traffic.

Track A – Session 4: Data Archiving

Information Technology Meets Engineering & Transportation Planning

Dawn Doyle

The Texas Department of Transportation (TxDOT) is in the process of developing an enterprise software application that is a browser-based, multi-tiered client/server, object-oriented relational database with spatial features designed to facilitate the analysis of traffic data for use in transportation planning and design. TxDOT's *Statewide Traffic Analysis and Reporting System* (STARS) integrates most traffic monitoring functions while improving the statistical engineering formulae used in the traffic data analysis. The first release of STARS is designed to meet the new Federal Highway Administration *Traffic Monitoring Guidelines* and *Pavement Design Guidelines*. Subsequent releases of STARS will provide full functionality, automation and access to the fully integrated and improved TxDOT traffic monitoring system.

Because too frequently sponsoring entities have grossly underestimated the complexity and degree of commitment to bring an enterprise database to fruition, TxDOT employs many unique processes to ensure success. During the project initiation stage, TxDOT defined all management practices to be followed, including:

- *Management Practices and Procedures*
- *Risk Assessment*
- *Change Control Processes*
- *Critical Performance Model*
- *System Requirements Specifications* (joint development)
- *Traceability Matrix*

But, more importantly are the deliverables-based contract's value-added planning steps. Each deliverable is governed by a jointly developed deliverable charter in which vendor, Transportation Planning and Information Systems personnel prescribe expectations, timelines, review conditions, milestones, resources, and costs in detail. Other key elements include required on-site vendor staffing and project management; adequate TxDOT staffing; interactive development; and continuous quality assurance practices.

Track B – Session 3: Non-Traditional Data Sources

Intelligent Transportation Infrastructure Program

Chung Eng

Section 5117(b)(3) of TEA-21 provided for the establishment of an Intelligent Transportation Infrastructure Program (ITIP) to "advance the deployment of an operational intelligent transportation infrastructure system for the measurement of various transportation system activities to aid in the transportation planning and analysis while making a significant contribution to the ITS program." Subsequent language in section 378 of the FY 2001 Transportation Appropriations Act, and in section 1101 of the FY 2002 Defense Appropriations Act, provided for the possible expansion of this program into a total of twenty-nine specified metropolitan areas. This presentation will provide background information on how the program was initiated, progress to date, and the future direction of the program.

Track A – Session 12: 2002 Pavement Design Guide

Summary of Recommendations from the Traffic Monitoring Guide

Tony Esteve

The 2001 Traffic Monitoring Guide recommends improvement in traffic data collection programs to meet most identified traffic data needs including the new mechanistic pavement design and the Highway Performance Monitoring System (HPMS). Traffic data programs are basic functions of highway agencies and typically collect traffic volume, vehicle classification, and truck weight data. Traffic volume programs consist of a small number of continuous counters providing detailed temporal data and a large number of portable counts providing complete system coverage. Estimates of traffic volume are based on factors and presented as annual average daily traffic (AADT). Vehicle classification data programs should be expanded and structured like volume programs, providing both continuous and portable coverage data converted to annual estimates. To ameliorate safety and equipment concerns, the option of collecting length classification instead of the standard 13 classes is offered. The weigh-in-motion (WIM) program emphasizes the use of permanent installations and the development of road groups to guide inferences on weights and loads.

Track C - Session 4: Estimation of Truck Traffic Volumes

Truck Traffic Flow for Highway Capacity Analysis

Edward Fekpe and Mohammed Alam

The paper describes the development of truck traffic flow maps for the purposes of highway capacity analysis. State truck traffic count data were integrated and merged with the national highway Planning Network within a GIS framework. The flow map forms the basis for analysis of the highway capacity effects of estimated future truck traffic flows.

Track C – Session 7: ITS Archived Data – Now and the Future

ITS: A Resource for Archived Traffic Data

Kim Ferroni

PENNDOT's Bureau of Planning and Research collects statewide traffic data through a variety of monitoring devices deployed on roadways across the state. The data is reported to the Federal Highway Administration on an annual basis and used for transportation decision-making related to highway funding, traffic engineering, highway design, planning and programming and highway maintenance and construction. Through coordination with PENNDOT's Bureau of Highway Safety and Traffic Engineering (BHSTE) and various PENNDOT Engineering Districts, BPR has begun to investigate the feasibility of capturing archived traffic data from ITS devices, such as remote traffic microwave sensors (RTMS), video detection, and traffic signals that were originally installed for traffic management. As part of the investigation, BPR is analyzing the quality of archived data from ITS devices and working to integrate the data into the statewide traffic data collection program. By archiving the real time data provided by these systems, PENNDOT can greatly expand its traffic data collection activities.

Poster Session

Making Traffic Cameras Smart

Gary Flynn

A display of "smart camera" software which enables DOTs to use existing "dumb" cameras to automatically collect traffic data such as count, volume, classification (by length) and turning movements.

Track B – Session 12: Future Data Programs and Performance Measures

Future Uses of AVL/APC Data

Tom Friedman

Track B – Session 2: Privatizing Traffic Monitoring Programs

Ohio DOT Privatization Activities

Dave Gardner

Purpose

Many traffic monitoring programs throughout the country have seen major changes in the way they operate and do business over the past several years. Ohio's program is no exception. Although Ohio has not "Privatized" its entire operation, it is has begun, over the past several years, to use the services of the private sector to do business. In the past, our traffic monitoring section handled all aspects of the program including permanent site installation, maintenance, short-term data collection, and data processing. With a decrease of approx. 25 staff over the past 10 years, using private sector resources and services has become essential to doing business.

Methodology

Beginning in 1998, the traffic monitoring section began implementing a number of "privatizing" activities to supplement our data collection program. They are as follows:

1) The traffic monitoring section has written and executed 5 separate contracts to install approximately 44 Weigh-In-Motion (WIM) sites and 54 Automatic Vehicle Classification (AVC) sites throughout the state. The actual installation began in June of 1999 and continues as of November 2001.

2) Due to the lack of central office staff, in 1998 the traffic monitoring section began "contracting" with our 12 ODOT district offices to collect short-term counts. Since 1998, we have collected and processed over 11,000 short-term vehicle volume and classification counts using district personnel.

3) In October of 2001, the traffic monitoring section began executing a contract with a consultant to handle special request counts that cannot be covered by the ODOT district counting crews. This contract covers all request needs for manual and 24hr/48hr. vehicle volume and classification counts.

Conclusion

This presentation will discuss the Ohio DOT's experiences and lessons learned using the above private sector resources and services.

Track C – Session 7: ITS Archived Data – Now and the Future

The Status of ADUS

Ralph Gillmann

The Archived Data User Service (ADUS) program is funded by the ITS Joint Program Office which focuses on research, development, and promotion of the re-use of data collected for ITS. This presentation will give an overview and update of the Federal program and other related activities. Recent and current activities include cross-cutting studies and state-of-the-practice reviews, data modeling, a field operational test, and data

Track B – Session 8: Integration of Data Sources

Issues for Real-Time Data Integration

Steve Gordon

Poster Session

Advances in Fiberoptic Sensors for Classification and WIM

Barry Grossman

Performance of permanent fiberoptic sensors having a sensitivity uniformity of better than 5%, and in some cases of better than 2% across their length will be presented along with new concepts in fiberoptic sensors.

Track C – Session 2: Congestion Management Systems: The Role of Travel and Traffic Data

CMS Data and Multimodal LOS Applications: Florida DOT

Martin Guttenplan

All Florida Metropolitan Planning Organizations (MPOs) have Congestion Management Systems (CMS). Using motor vehicle counts, a generalized screening of analysis of automobile Level of Service (LOS) is performed Roadways exceeding a specified threshold undergo detailed analysis leading to improvements. Though many of the CMS plans recommend multimodal approaches to relieve congestion, Only 7 of 25 MPO's had performance measures to assess the pedestrian, bicycle or transit modes because there were no tools available to effectively measure their impacts.

FDOT researchers sought to refine available models and develop necessary models including the validation of a Pedestrian Level of Service model. Researchers identified factors within the right-of-way that *significantly influence* the pedestrian's feeling of safety and/or comfort These factors included: the presence of a sidewalk; lateral separation from motor vehicle traffic; barriers and buffers between pedestrians and motor vehicle traffic; motor vehicle volume and composition; the effects of motor vehicle traffic speed; and, driveway frequency and access volume

They used real-time responses from pedestrians walking on actual roadway segments. The result was the ability to quantify perceived safety or comfort (with respect to the presence of motor vehicle traffic) as a stand-alone performance measure. FDOT's work integrates incorporates planning level assumptions and integrates this pedestrian LOS model with SCI's Bicycle Level of Service Model, the Transit Capacity and Quality of Service Manual and the Highway Capacity Manual to allow for a true multimodal LOS analysis on roadway facility and segments.

Track B -- Session 8: Integration of Data Sources

Integration of Multiple Data Sources to Provide Truck Performance Monitoring

Mark Hallenbeck and Ed McCormack

As congestion increases, regional transportation agencies are seeking facility travel time data to determine exactly when, how, and where congestion affects freight and personal mobility. Access to this information lets roadway jurisdictions effectively prioritize their available facility improvement funds, as well as monitor the effects of those improvements. Unfortunately, limited budgets exist for the collection of the data needed to measure facility performance, and thus it is hard to develop robust data sets which provide the performance information needed for reporting on trucking delays.

One solution to this set of problems is to obtain, combine, and report data from a variety of ITS data sources. ITS data sources usually exist for specific system management or facility operations purposes, but can supply the highway agency with significant amounts of roadway performance data. Thus, relatively little money is needed to convert available data sources into tools which provide facility performance information. Unfortunately, ITS data sources tend to cover limited geographic areas or limited vehicle fleets. Integrating the data from multiple data sources allows for development of a more complete picture of region wide facility performance.

This presentation discusses the current status of a USDOT/WSDOT funded research project designed to combine the data from a variety of ITS sources, in order to create a more robust facility performance system. The specific goal of the project is to develop and test a system that can report on delays experienced by trucks on a wide variety of roads in the western portion of the State of Washington.

The tests combined data from the region's CVISN truck tag readers, an on-going container seal transponder tracking system, the region's freeway monitoring system, and a GPS based, wireless, truck tracking system. Only the last of these systems was installed specifically for this test. The rest of the integrated data sources are part of on-going ITS operational systems being deployed by the State of Washington.

This presentation discusses the types of data that are being collected, the types of facility performance measures that can be reported, the issues that must be surmounted when integrating these diverse data sets, and the benefits that can be gained by using multiple data sets.

Track C – Session 6: Making the Connection Between ITS and Traffic Monitoring

All RHODES Lead to Seattle: Getting Useful Arterial Street Data from the RHODES Traffic Signal Control Software

Mark Hallenbeck

The operational test of the RHODES traffic signal system taking place in Seattle has allowed the Washington State Department of Transportation to investigate new ways of extracting arterial data from traffic management systems. This presentation will describe what data we are able to obtain, how we are obtaining that data, what performance measures can be computed with that data, and how new performance measures are being used both for both operations planning and more conventional planning activities.

Poster Session

Portable and Permanent site HS WIM Data Comparison

John Harris

In July 1999 PEEK UK Ltd. in cooperation with KOAC•WMD, the Dutch Road Research Laboratory installed a portable WIM system on a provincial road in the eastern part of the Netherlands near Apeldoorn. The system consisted of a Peek ADR 1000 WIM recorder using two, 3 meter long 'slim WIM' sensors (section size 7mm x 2mm supplied by MSI in the USA). These sensors were held in a bituminous envelope tape, applied to the highway in a transverse direction to the passing traffic. With a sensor spacing of 3 meters, dynamic weight data for axle loads was collected and compared with post random weighings of the same passing Heavy Goods Vehicles. From this axle load data, speed and axle configuration data, weighing accuracy were computed. Road surface temperature was also monitored. The results of the dynamic weighings were processed using the Peek VISA-WIM software. The system was calibrated prior to any static load measurements being collected by using a single truck with known axle loads. The system also had an auto calibration mode, which was not tested during the initial trial.

Track C – Session 3: Issues in Urban Traffic Data

Urban Traffic Data Collection by the Georgia Department of Transportation

Ron Harris

Ron Harris of the Georgia Department of Transportation is managing a project to upgrade the automatic traffic recorder (ATR) system in the metropolitan Atlanta area. The Data Collection Bureau selected locations along interstate highways and other functional categories of roadways at which traffic counts are needed. A contract has been awarded for the installation of new ATR sites and upgrade of existing sites using an appropriate mix of in-pavement and non-intrusive sensors. The contractor is also performing preventive and corrective maintenance of the sites to ensure continuous collection of traffic count data. Other projects being managed by the Data Collection Bureau include monitoring high occupancy vehicle (HOV) lane usage and assisting researchers in collecting data for an FHWA particulate matter study. These latter two projects address demands for traffic data in urban areas that go beyond the traditional traffic count data that are collected, processed, and reported to federal agencies and other users. The presentation will cover system configuration, data collection equipment, and data transfer, quality control, and reporting. The presentation will also cover the use of contracts for installation and maintenance of ATR sites and for collecting HOV lane usage data and other types of urban traffic data.

Track A – Session 8: Automatic Traffic Recorder Fundamentals

Lightning Suppression at Telemetered Traffic Monitoring Sites (TTMS)

Bruce A. Harvey, Michael P. Akali, and Salman A. Siddiqui

Florida's propensity for lightning puts a tremendous burden on surge protectors for the states over 300 telemetered traffic monitoring sites (TTMS's). The Florida Department of Transportation (FDOT) in conjunction with the FAMU-FSU College of Engineering have embarked on a project to improve the surge protection of the TTMS equipment initially focusing on the telephone line surge protection devices. The goal of the project is to develop a standard for lightning surge protection and a compliance testing procedure.

To determine the causes of failure the initial task was to physically examine failed surge protectors retrieved from the TTMS's. Next, a voltage monitoring system was installed at a few sites to measure the frequency of phone line surges experienced by the surge protector. Finally a surge generator was purchased to test the resilience and endurance of the surge protectors, and to attempt to recreate the surge conditions causing the protector failures. Results from the physical examinations and surge monitoring indicate that a majority of the surge devices fail not from an exceptionally large surge (>10 kA), but instead from the large number of more moderate size surges. Initial test results using the surge generator have supported this conclusion by demonstrating the damage caused by large surges does not match the damage seen in the field. This paper will detail the test procedures and equipment used, summarize the results from the efforts thus far, and present initial conclusions and recommendations for standards and compliance test procedures.

Track A – Session 8: Automatic Traffic Recorder Fundamentals

Tests and Analysis of Analog Modems for Remote Data Collection at Telemetered Traffic Monitoring Sites (TTMS)

Bruce A. Harvey, Salman A. Siddiqui, and Michael P. Akali

Florida's Department of Transport (FDOT) has over three hundred telemetered traffic monitoring sites (TTMSs) of which majority of the sites use DC-powered, industrial modems that operate at low speeds to transfer downloaded traffic data to the head quarters. Incompatibility and poor performance of these modems motivated this study into the causes of problems between various modems and the development of a standard for analog modem purchases and a test procedure to evaluate under the developed standard.

This paper studies the affects of the modem's chipsets, manufacturers, protocols and the various conditions of a telephone line that affect the performance of analog modems. This study would be used to develop a standard for testing modem performance and compatibility, and a test procedure to test the modem to the developed standard.

With this in sight, the methods of testing analog modems will be discussed using a telephone line emulator (TLE) to simulate various telephone line conditions. The idea is to have two modems communicate through the TLE and study the compatibility and performance issues. The TLE, manufactured by Teltone, was used to simulate line conditions with only white noise affect, only attenuation affect and finally the affect of the two factors simultaneously. All these factors were used on different set of modems (with different chipsets, protocols and manufacturers). The results of these tests are used to evaluate the critical points of modem performance and develop a standard for selecting modem along with a test procedure to verify performance to the developed standard.

Track B – Session 12: Future Data Programs and Performance Measures

An Investigation of the Use of Aerial Video for Traffic Data Collection

Mark Hickman and Alejandro Angel

The effective short-term and long-term management of transportation facilities requires data, translated to information, on the utilization of these facilities. Researchers at the University of Arizona are investigating the potential of remotely sensed data, using aerial video, to enhance existing data sources and therefore to improve traffic management. Currently, airborne sensing platforms can provide sufficient resolution and associated image processing speeds to sense vehicle locations and movements across broader spatial and temporal scales than more traditional methods. The research has examined the use of digital video, global positioning systems (GPS), and automated image processing to improve the accuracy and cost-effectiveness of the data collection and reduction.

Two recent "proof-of-concept" experiments, in which video and GPS data were collected from a major arterial and from a freeway, are described. Using this imagery, vehicle speeds, densities, travel times over extended road segments, delays, turning counts, queue lengths, and measures of platoon dispersion were obtained. As part of the two experiments, travel times from the aerial video were compared with "ground truth" measurements using the more traditional data collection methods of a test car and vehicle/license plate matching.

The results suggest that the aerial video may produce estimates of traffic flow parameters that have similar accuracy, but higher statistical confidence and level of detail, than these more traditional techniques. Based on these preliminary results and recent progress in automated image processing, it is conjectured that aerial video may become a cost-effective alternative to other forms of traffic data collection, in the long term.

Poster Session

Traffic Monitoring Activities at the Kansas DOT

Bill Hughes

Products from KDOT's traffic monitoring program.

Track C - Session 4: Estimation of Truck Traffic Volumes

Freight Movements in the Orlando Urbanized Area

David Hunt

The Orlando Urbanized Area is confronted with several interesting freight issues. First, the freight system must support the current needs of residents and businesses in Orlando and allow for economic growth. Second, Orlando is one of the premier tourist locations in the world and the freight system has to efficiently and effectively support this industry. Finally, Orlando is geographically located in the center of Florida and has become a staging area for shipments to South Florida. This presentation will describe a current study for MetroPlan Orlando, including the methodology used to estimate current and future freight volumes and some of the key findings.

Track A – Session 2: Traditional Sensors

Traditional WIM Sensors Experiences in Kentucky

Dan.Inabnitt

The Kentucky Transportation Cabinet has been collecting truck weight data using weigh-in-motion technologies since 1986. Assorted sensors have been used with a wide range of successes and failures with each. Sensors discussed will include capacitance mat, rigid channel Phillips, Amp BLC, Amp BL, bending plate and load cell. Site selection and installation information will also be discussed.

Track C – Session 11: Innovative Uses and Applications of ITS/Operations Data Archives

Use of ITS Data for Reliability and the Florida Reliability Method

Dena Jackson

This presentation will highlight the use of archived data in the development and estimation of the Florida Reliability Method. The Florida Reliability Method is based on a benchmarking technique and is derived from the Florida DOT's definition of reliability as the percent of travel on a corridor that takes no longer than the expected travel time plus a certain acceptable additional time. The method was validated using a 23-mile segment of I-405 in Seattle, Washington. The archived data consisted of a 3-month sample of traffic flow data collected at 5-minute intervals. This data was converted into corridor travel times based on average flow rates and speeds on individual segments. From these results, the reliability of the corridor was estimated. Data collection requirements regarding sample size and aggregation interval for estimating reliability will also be presented.

Poster Session

Ohio's FHWA Scheme F Classification Tree

Steven Jessberger

An axle class tree that has been improved to better classify some vehicle types; i.e. concrete trucks, buses, extra dump truck axles, etc.

Track A – Session 6: Quality Control of Data

NATMEC - Ohio Traffic Data Quality Control Procedures

Steven Jessberger

The Ohio Department of Transportation (ODOT) is in the process of rewriting/upgrading our current software that is used to process traffic data from all of our permanent, portable, and manual traffic counting locations. Quality checks will be conducted on volume, classification (axle or length), and weigh-in-motion (WIM) data. (Traffic Monitoring Guide format).

The following validation checks will be performed on volume data:

1) Basic station information check
2) Extreme values check (max daily, min daily, and max by hour by lane)
3) Zero checks using bound values check
4) Historical rolling average check (6 week)
5) Monthly average daily traffic (MADT) check (previous month and previous year)
6) Directional distribution check

The following validation checks will be performed on classification data:

1) All of the above checks listed for volume data
2) By day of week (DOW) % of each classification check

The following validation checks will be performed on weigh-in-motion data:

1) By DOW % of each classification check
2) Maximum gross vehicle weight (GVW) limit based on classification
3) Front steering axle weight range check for classifications 8 -15
4) Any single axle weight check
5) Axle spacing range check
6) # of axle spacings, # of axles, and # of axle weights check
7) Maximum axle spacing limit based on classification
8) GVW vs total of all axle weights check
9) 5 point historical weight distribution calibration check (Wednesday) (used to verify the calibration of the site)

By having all of our traffic data quality checked with consistent methods, we will be able to provide our customers with more accurate data. The presentation will specifically go over the reasons why the above checks will be included in our quality control procedures (with examples). In addition, the presenter will discuss ODOT's new classification tree that correctly classifies many of the incorrectly classified vehicles used in other classification schemes.

Track C – Session 6: Making the Connection Between ITS and Traffic Monitoring

Building Data "Bridges" between Operations and Planning: Case Study in Pittsburgh and Philadelphia, Pennsylvania

Terri Z. Johnson

In a unique partnership, Mobility Technologies, Inc. has deployed traffic sensors and is providing traveler information in the Pittsburgh and Philadelphia areas. Part of their standard operation is the archiving of all data into a data warehouse. Mobility Technologies then makes this archived data available to PennDOT and other public sector agencies. Thus far, PennDOT has been eager to utilize this additional data source for planning purposes. This presentation will discuss this deployment in Pennsylvania, focusing on lessons learned and institutional issues. The presentation will also highlight innovative examples of how the data can be used in operations and management activities.

Joint Track – Session 9: Combined NATMEC/ICWIM Session

Summary of U.S. National and Regional Trends in Truck Loading

David Jones

This presentation summarizes national and regional trends in truck loading in the United States on the Interstate System from 1990 to 2000. The data are from the Truck Weight Study, which consists of vehicle classification and weigh-in-motion (WIM) data submitted by State highway agencies. The Vehicle Travel Information System (VTRIS) is used to process the data. Daily traffic and loadings are summarized and compared by year and by region.

Track A – Session 11: Weigh In Motion

Evaluation of Quartz Piezoelectric WIM Using Enforcement Data

Kip Jones

The Florida Department of Transportation has constructed a test facility to evaluate new weigh-in-motion equipment. A study was conducted to examine individual vehicle data collected at the WIM test site using quartz element piezoelectric weight sensors and comparing those records with data collected at a static scale enforcement site.

This presentation will detail the methods used to collect the data and a discussion of the results obtained from the study.

Track B – Session 6: Remote Sensing

Use of Remote Sensing to Evaluate and Measure Highway Traffic Flows

Gregory Jordan

Joint Track -- Session 9: Combined NATMEC/ICWIM Session

The Evolution of Vehicle Weighing in the United States

Perry M. Kent

With the patenting of the platform scale by Thaddeus Fairbanks in 1831, a new and interesting era of development was opened. Originally, these scales were used to determine the commercial value of a commodity being carried by a wagon being pulled by a team of horses. Requiring a solid foundation, these scales were very accurate, but extremely expensive. As the motor vehicle entered into the picture, this same methodology for weighing continued.

Over the ensuing years since the platform scale was patented, it was becoming clear that there had to be some way of protecting and managing the roadways. In 1935, the Bureau of Public Roads (BPR) began the Highway Planning Surveys, whereby the State highway agencies collected vehicle weight information to be forwarded to the Federal government. This was made possible by the development of portable weighing devices, often referred to as "loadometers."

Not long after the introduction of the loadometers, research began in this country on a concept that would eventually lead to the in-motion weighing of highway vehicles. Pioneered by individuals like O. K. Normann and Richard Hopkins of the BPR, theories were pursued and tested. Early versions of these massive weigh-in-motion devices were placed in roadways, utilizing strain-gauge load cell technology.

With the arrival of the Interstate highway system came the increased demand for a more efficient method for weighing trucks. By this time, the use of the BRP-type weigh-in-motion scales had been largely abandoned. Technology had turned toward other directions. Armed with desktop computers, researchers and engineers were progressing in such fields as more compact load cells, different types of strain gauges, capacitance mats, bending plates, piezoelectric cables and more. Today, the technology of weighing-in-motion of highway vehicles seems limited only by ones imagination.

Track C – Session 8: Monitoring for North American Cross Border Traffic

The US DOT's Freight Analysis Framework

Bruce Lambert

Growing demands for passenger and freight movement through urban and border areas has increased congestion and inefficiencies throughout the entire transportation system. One area of consideration is the nation's gateways. Currently, many of the nation's ports and border crossings are facing increased concerns over capacity, in addition to the growing focus on national security. The importance of using data to strategically view each facility is becoming critical in fulfilling program needs for many different federal agencies.

FHWA has developed a Freight Productivity Program to understand freight demands, to assess the implications for the surface transportation system, and to develop policy and program initiatives to improve freight efficiency. The Freight Analysis Framework (FAF) is the policy and systems analysis tool developed to support this effort. The FAF is a methodology to estimate trade flows on the Nation's infrastructure, seeking to understand the geographic relationships between local flows and the Nation's overall transportation system. The framework will help to identify areas of improvement to increase freight mobility, including highlighting regions with mismatched freight demand and system capacity, and encouraging the development of multi-state and regional approaches to improving operations.

The presentation will discuss the development of Freight Analysis Framework, and its relationship to international gateways and other data traffic efforts occurring both within DOT and with other interested groups.

Track B – Session 8: Integration of Data Sources

Integration of Road Inventory and Traffic Counting Programs

Kirk B. Mangold

By April INDOT should have completed a pilot and started statewide implementation of a statewide Road Inventory GIS covering over 93,000 miles using Exor's Highways and ESRI's mapping product. INDOT is contracting with the MPOs to do traffic counting for the state. INDOT is also working with Rural Planning Organizations (RPOs) to develop a traffic counting program and standardizing the collection and analysis of the traffic count data. In 2003 INDOT will combine the Road Inventory Program with the Traffic Counting Program utilizing Exor's Traffic Management module.

Track C – Session 7: ITS Archived Data – Now and the Future

ITS as a Data Source for Traditional Transportation Information Systems

Richard Margiotta

One of the many potential uses of data generated from ITS technologies is as a source for "traditional" transportation information systems. Traditional data systems are those that have developed their own data collection and input methods and are used for a variety of missions. There is a substantial amount of overlap in the data collected by these systems and by ITS.

This study examined the data definitions in the ITS data dictionaries and the National ITS Architecture and compared them with the definitions in traditional information systems.

The ITS data dictionaries examined were the Traffic Management Data Dictionary, P1512 Incident Management Data Dictionary, and Advanced Traveler Information Systems Data Dictionary. Traditional systems included the Fatality Analysis Reporting System, General Estimates System, Highway Performance Monitoring System, Vehicle Inventory and Use Survey, Traffic Monitoring Guide, National Personal Transportation Survey, Highway Safety Information System, National Bridge Inventory, Motor Carrier Management Information System, National Governors' Association Truck Data Elements, and Hazardous Material Incident Reporting System.

Differences in the definitions are noted and recommendations for their reconciliation are presented. Although the main focus of the study was the technical comparison, observations and recommendations for the institutional necessary to make the transfer of data from ITS to traditional systems are also made.

Poster Session

Florida's State-of-the-Art Truck Weigh Stations

Barry Mason

An overview of the operation of Florida DOT's new truck weigh stations is presented on a CD Rom video. These new weigh stations utilize pre-pass and weigh-in-motion screening technology to minimize the delay involved in weighing trucks. Only those trucks suspected of being overweight are directed to stop on the weigh scales--all others are allowed to proceed without stopping. This video shows the operation from both the inspector's and the truck driver's perspective.

Track B – Session 6: Remote Sensing

Space- and air-based remote sensing of transportation flows: promising applications

Mark McCord

This talk will review progress in several research projects that indicate the potential value of using traffic flow data remotely sensed from air- or space-based platforms in common transportation problems. Featured projects include: the use of satellite-based imagery to improve AADT and VMT estimation in statewide traffic monitoring programs; the value of remotely sensed data to improve OD estimation; and helicopter-based video for velocity estimation. Results show that using remote sensing data improves accuracy, provides richer data, or both. Moreover, the applications addressed are common and recurring, implying the potential for broad and repeated use of remotely sensed flow data. Image processing and sensor developments related to remote sensing of transportation flow will also be summarized.

Track C – Session 8: Monitoring for North American Cross Border Traffic

Cross Border U.S. – Mexico Traffic

John P. McCray

Truck movements between the U.S. and Mexico are subject to a number of counts including bridge counts, Customs counts, local traffic counts, and where available weight-in-motion and safety inspection counts. This presentation will discuss the usefulness and availability of the truck count data and how the data can be used in transportation studies.

Track A—Session 11: Weigh In Motion

Evaluation of a Weigh-In-Motion System Utilizing Quartz-Piezoelectric Sensor Technology

Anne-Marie H. McDonnell

The final results from the evaluation of a system utilizing quartz-piezoelectric sensor technology conducted by the Connecticut Department of Transportation in cooperation with the Federal Highway Administration will be presented. The sensors were installed as part of a study to determine the sensor survivability, accuracy and reliability under actual traffic conditions in Connecticut's environment between 1998 and 2001. Pavement profile data, site and sensor configuration information, summary information from seven different field validation sessions using trucks of known static weight, as well as relevant issues encountered during the evaluation period, are included.

Track B – Session 2: Privatization of Traffic Data Collection

An Arkansas Experience

Keith Merritt

The Arkansas Highway and Transportation Department by Commission action in 1997 began to identify certain tasks that would be advantageous to the Department to privatize in the Traffic Data Collection process. Through careful study and accounting methods found in the "Reason Foundation" publication, the Department has successfully privatized the construction of 6 W-I-M sites, 400 Turning Movement Surveys and 19,000 Traffic Volume Counts to date.

This presentation will be specific to the overall process including the initial decision to privatize, the Notice Seeking Letters Of Interest, Requests For Proposals, the selection of the Consultant and Quality Control during the Contract.

Poster Session

Top Trial Project

Ralph Meschede

Future improvements for Traffic Monitoring and Control are urgently necessary to achieve higher safety and economy on the European motorway network. Better and fair control of heavy goods transportation must be solved on European scale. 4 countries join this trial with users, industry and administrations to test new WIM technologies to reduce: - the impact of overloaded heavy goods vehicles on the road safety - the serious damages caused on road infrastructure with tremendous repair costs, by investigating and optimizing technical and administrative solutions. The TOP TRIAL project will last 23 months, build up the necessary complex test site, perform trials for 1 year with multi sensors and algorithms, optimize accuracy for enforcement and proposes new procedures for overload control. Results: - Improvement measurement accuracy of WIM arrays. – Draft of future European standards for overload enforcement. - Dissemination to users.

Track A – Session 3: Non-Traditional Sensors

Status of the Vehicle Detector Clearinghouse (VDC)

Luz Elena Y. Mimbela

The Vehicle Detector Clearinghouse (VDC) is a multi-state, pooled-fund project sponsored in cooperation with the U.S. Department of Transportation (U.S. DOT) Federal Highway Administration (FHWA). The VDC mission is "to provide information to transportation agencies on the capabilities of commercially-available vehicle detectors by gathering, organizing, and sharing information concerning tests and test procedures in a timely, efficient, and cost-effective manner. Furthermore, the clearinghouse will be a catalyst for developing standard test protocols so that no matter who performs the tests, the results will be widely acceptable.

Currently, VDC information is available primarily via the VDC web site and the VDC Newsletter. The VDC web site can be accessed at the following URL: http://www.nmsu.edu/~traffic/. The VDC web site includes several searchable databases with information on data collection equipment and products used for traffic monitoring applications, such as, weigh-in-motion (WIM), speed monitoring, traffic counting, and vehicle classification.

Another method of facilitating a communication network within the vehicle detector expert, manufacturer, and research community is via the VDCLS, the Vehicle Detector Clearinghouse Listserv. The listserv functions somewhat like an electronic bulletin board, but is more of a mail distribution center and means for users to contact other users. In addition, the VDC has utilized its expertise on these technologies to complete a recent State-of-the-Art study for the use of fiber optic sensors in WIM system applications. Currently, the VDC is in the process of developing several proposals to expand its activities to include: 1) testing of new standards developed for traffic monitoring equipment, 2) working hand-in-hand with LTAP entities across the US to help with facilitating workshops to provide training to traffic monitoring personnel and others, and 3) develop and launch web-based training modules on vehicle detectors for traffic monitoring personnel and others.

Track A – Session 3: Non-Traditional Sensors

Update of the Evaluation of Non-Intrusive Technologies for Traffic Detection

Erik D. Minge and Farideh Amiri

Purpose: A comprehensive evaluation of non-intrusive technologies for traffic detection – the NIT Project – is being conducted in Minneapolis, Minnesota. The NIT project examines how non-intrusive technologies can be used to augment or replace current traffic data collection methods, such as inductive loop detectors, pneumatic road tubes, and manual counting. The project's emphasis is to make test results useful to data collection practitioners from around the country. The current phase of testing builds on the success of Phase 1, completed in 1997, by examining detection applications to Intelligent Transportation Systems (ITS), traffic control, and historic data collection needs. The Minnesota Department of Transportation and the Federal Highway Administration are conducting the project.

Methodology: The objectives of this project are to conduct extensive field tests of off-the-shelf non-intrusive sensors for use in a variety of applications and to assess the traffic data collection capabilities of each sensor. Emphasis is placed on urban traffic conditions, such as heavy congestion found at the I-394 test site, and performance in a wide variety of mounting configurations at both intersection and freeway test sites. Standardized testing criteria have been developed so that the results from this project can be directly and easily comparable to results obtained by other transportation agencies. In addition to vehicular traffic detection, a follow-up phase will examine the application to bicycle and pedestrian detection. Future test activities will examine train detection.

Conclusions: The NIT project provides a cost-effective platform for continuation of this important research and subsequent dissemination of findings. The NATMEC presentation will discuss early results. Beginning in October 2001, data has been collected over several 24-hour test periods representing different mounting locations and weather conditions. Field testing is scheduled to end in March 2002. Interim results are currently available on the project website: http://projects.state.mn.us/nit/. The NATMEC presentation will explore these results in more detail.

Poster Session

Performance of HGV's in a major Greek Road Network Using WIM Technology

George Mintsis

During the last twenty years an evolution in the Greek transportation system has been observed. As far as infrastructure is concerned, the development of the two main road links of PATHE and EGNATIA ODOS, that are part of the Trans-European Road Network (TERN), is the dominant issue. However, as far as operation is concerned, the increase in the use of HGVs can be considered as one of the main elements. The total amount of HGVs transported goods for an average working day in Greece is about 500,000 tones corresponding to about 70,000 trips. According to the results of the National Origin-Destination Survey, there is an annual increase of about 3% in the HGVs traffic during the period 1980-1995. The increase of the HGVs traffic and the development of main road links raise the need for the study of the characteristics of the HGVs that use the network, and the study of their impact to the capital, maintenance and operational cost of the network and the users respectively as well as to the environment.

The main objective of the project is to record dynamic characteristics of the HGVs using the road links under study, and to calculate basic statistics that describe the population, estimate overweighing and allow the development of a computer-map interactive system (G.I.S) to function as a dynamic data base for HGVs for the main national road network. Furthermore, the project aims to the development of simple and useful indexes for the estimation of the dynamic characteristic of the HGVs with only the use of traffic flow and classification figures for the HGVs under study. Therefore, the respective road authorities could easily determine HGVs data using available, ordinary traffic data, which can be obtained with relatively low cost surveys. Finally, the project will consider the evolution of the HGVs dynamic data using measurements that were taken at some position, in different time periods, in order to examine the existence of specific trends that can be safely considered in development studies of the road, or even more, the transport network in Greece.

Track B – Session 4: State of the Art for Travel Time Data Collection and Analysis

Travel Time for Performance Measures

Gordon Morgan

There are many ways to measure travel time, some old and some new. When we can't measure travel time, we can calculate it (approximately) using equations based on empirically derived speed-flow relationships. But I'll be talking about the uses of the travel time data that we measure or calculate. Travel time alone has its uses, but it's not very useful as a Performance Measure. With various kinds of travel time comparisons, however, we can help transportation agencies analyze route impacts and make construction decisions, help shippers and transit agencies with route decisions, and help national decision makers define and allocate resources. I'll discuss these uses and how they relate to the ways that travel time data are collected, with special emphasis on one of the newer and more demanding uses: estimating travel time reliability.

Track B – Session 11: MPO Uses of Urban Traffic Monitoring Data

Integration of Traffic and Transportation System Data for Use in Travel Demand Analysis

Andy Mullins

As a result of the level of travel and congestion in the Houston-Galveston region and more precisely the continued level of growth and travel and congestion, the region has historically been the subject of a rather large amount of data collection. Although data is collected by a relatively few number of entities, the degree of consistency in the level of detail of the data, methods for representing and storing the data and process for reporting the data vary.

The data needs of travel demand analysis tools are growing in terms of the amount and level-of-detail due to the increasing use of travel demand analysis tools in transportation and air quality analysis and planning. At the same time, tools for developing, maintaining and analyzing data in great detail are also readily available. With the proper level of communication between data collectors and data users and integration of the tools used by both, this data can be made available and used in ways the greatly increase its usefulness.

H-GAC is working with those agencies collecting this data in an effort to ensure the data is collected, stored, maintained and communicated in a consistent manner and usable manner that also makes use of current analysis tools such as Geographic Information Systems and relational databases. The goal of this effort is to develop a standardized approach in collecting, summarizing and exchanging locally-collected transportation system and transportation operations data in sufficient detail and of sufficient quality to support it's use in travel demand analysis tool development and application.

Track A - Session 3: Non-Traditional Sensors

Overview of Private Sector Approaches for Estimating Traffic Flow using Aerial Photography and Videography

Alan T. Murray

This paper details current uses of airborne techniques (aerial photography and videography) for traffic flow estimation in the private sector. An overview of contemporary practices and companies providing services is presented. A characterization of key components of provided services is also given. The paper concludes with an outline of how planning organizations, such as MPOs, DOTs, and local agencies, could utilize such services.

Poster Session

Laboratory Evaluation of Adhesives Used in Installation of Piezoelectric Sensors

Renatus Mussa

Piezoelectric sensors are widely used by FDOT for traffic data collection of volumes, speed, classification, and weigh-in-motion. Long-term observation of sensor performance in Florida suggested that the use of adhesives with characteristics unsuitable for Florida traffic, pavement, and environmental conditions might be contributing to premature failures of piezoelectric sensors. Several tests including vicat setting time, viscosity, water absorption, hardness, compressive strength, flexural bonding strength, peel strength and heat transfer test were conducted in order to study the effects of different factors on the performance of the adhesives used in Florida. The results of the above tests have been summarized and would be displayed in posters at NATMEC 2002 in Orlando, Florida.

Track C -- Session 2: Congestion Management Systems: The Role of Travel and Traffic Data

CMS Data and Applications: Hampton Roads MPO

Keith M. Nichols

The Hampton Roads Planning District Commission (HRPDC) is committed to the development and continuing maintenance of a CMS for the Hampton Roads region. The vision of the Hampton Roads regional CMS is based on an on-going process that provides a forum for the identification of congested locations, as well as the problems and causes that make these locations congested. The process also identifies appropriate mitigation strategies that focus on improving transportation system efficiency.

The Hampton Roads CMS database includes a monitoring element consisting of an extensive compilation of data including existing traffic counts, historical trends, roadway characteristics, travel time and speed data, traffic accident data, and projected growth rates of vehicle miles of travel for over 4,100 lane-miles of regional roadways.

Travel time and speed data have been extensively collected and analyzed since the 1980's. This information was updated in year 2000 with a new system using Global Positioning System (GPS) and GIS technology. This information is used to gauge the effectiveness of the roadway system and track changes in travel time, trends of improvement or degradation, and evaluate the impacts of transportation improvements on travel times throughout the region.

This paper presents an overview of CMS applications in Hampton Roads, particularly, in the areas of data collection and travel information system. The benefits and techniques used for the CMS data collection and monitoring system are also examined.

Track A – Session 7: LTPP Specific Pavement Studies

Pilot Studies and Lessons Learned

Barbara K. Ostrom

The need to provide support to state agencies in meeting their commitments for continuous traffic data at SPS-1, -2, -5 and –6 locations has led FHWA to develop the SPS Traffic Pooled Fund. The LTPP Technical Support Services Contractor (TSSC) has assisted in this effort through the development of the action plan to the creation of the documents that typify LTPP data collection activities. In pursuit of research quality data, LTPP traditionally develops guidelines for instrumentation, field activities and quality control procedures to obtain uniformly collected, high quality data. For the SPS Traffic Pooled Fund, this effort includes guidelines for equipment and installation as well as a field manual of site evaluation practices to determine if research quality WIM data can be obtained from an existing installation.

This presentation discusses the elements of the field manual from pre-visit coordination, through truck selection, on-site data collection activities and through the reporting process to summarize site conditions. This process was validated during the summer and fall of 2001. The presentation includes some lessons learned and the results from the pilot sites.

Joint Track -- Session 5: ITS/Data General Session

Transportation Operations and Data - Making the Connection at TRB and AASHTO

Tom Palmerlee

Similar to most transportation organizations, TRB and AASHTO have organized their committees along functional lines of planning, design and construction, and operations. Many of the committees specializing in transportation data have been more closely affiliated with the planning and construction areas and those information technology committees with administration. As ITS becomes more widespread, sensors generate large amounts of data that potentially can replace traditional data sources. Likewise the systematic use of data systems techniques and analysis can support performance measures in the operations arena. This presentation reviews some of the initiatives at TRB and at AASTHO to use the collective skills of both the operations and data systems communities to assess opportunities for more effectively using operations generated data to manage the system and provide information to users.

Joint Track -- Session 5: ITS/Data General Session

Data Collection on the National Highway System - Requirements for a National "INFOstructure".

Jeff Paniati

In recent years, as travel has continued to outpace the addition of new capacity, the emphasis on efficient transportation operations has become exceedingly more important to the transportation managers and operators. The events of September 11 have brought the issue of security to the forefront. The ability of our political and transportation officials to manage the network under these stresses as well as under normal operating conditions requires fundamental knowledge of the current status of the system to deal with the security, mobility, and safety of the transportation system.

Operating the highway system to achieve security, safety, and reliability objectives requires an ability to know what is happening on the system. Real-time information on highway system performance, transit operations, weather conditions and major weather events is vital to assist transportation professionals in managing the available capacity, responding to disruptions to capacity (including emergencies, evacuations, and security threats), and to system users in planning the timing, mode, and route for their trips. While there is clearly a need for this information, it does not consistently exist in any State or metropolitan area in the United States.

There is need for a national investment in highway and transportation monitoring to support four key transportation objectives:

1. Improving the security of the surface transportation system
2. Addressing a growing congestion problem
3. Supporting improved response to weather events
4. Facilitation of national and regional traveler information

To achieve these four objectives requires a national “Infostructure” initiative that supports a balance between national information needs and local interests.

Track B – Session 7: Integration of Data Sources

Assessing Your Data Management Infrastructure: A Check-Off List for Data Integration Readiness

Daniel Papiernik and David Fletcher

Many transportation organizations can be characterized as working in data-rich but data-management-poor environments. Other industries have suffered under similar circumstances. This presentation will outline the efforts of a small cadre of transportation professionals who, in conjunction with TRB are undertaking the development of a check-off list that will extend the work already accomplished through the peer-exchange program to help transportation agencies improve their data management practices and succeed in sustaining quality data programs throughout their enterprise.

Joint Track -- Session 5: ITS/Data General Session

Using ITS Data In Measuring the Reliability of Transportation Network Performance

Vince Pearce

This presentation describes research sponsored by the Federal Highway Administration to examine how travel time reliability can be quantified, at multiple levels, using data generated by ITS freeway management systems in ten cities around the U.S. The presentation features the process followed in the project, its findings regarding measures and data issues, and views of several of the interesting characteristics discovered in the processed information.

Vince Pearce is a Transportation Specialist with FHWA's Office of Operations, leading the agency's efforts in traffic management. He has a bachelor's degree in mechanical engineering from NC State, an MBA from Harvard, and 24 years of professional experience. He has managed numerous transportation projects over the past 14 years in planning, design, implementation, and operation of traffic management systems, including design of over a dozen traffic management centers.

Track C – SESSION 3: Issues in Urban Traffic Data

Traffic Detectors: Are They Working?

Vince Pearce

Vince Pearce will share some experiences on problems associated with the traffic detectors. Insights will be sought from the audience on the scope of the problem and practices that improve performance of traffic detectors.

Track A – Session 12: 2002 Pavement Design Guide

The Use of Traffic Monitoring Data for the 2002 Pavement Design Guide

Kathy Petros

The pavement design community is currently in the process of developing a national pavement design guide based in part on mechanistic principles. The development of this design guide is being done under NCHRP 1-37A. Because it is scheduled for completion by the end of 2002, it is entitled the 2002 Guide for the Design of New and Rehabilitated Pavement Structures. One of the main factors affecting pavement performance is traffic loading and the 2002 Guide treats traffic data as a key design input. At the same time, it is recognized that optimal traffic data may not be available for every project, so the 2002 Guide will incorporate various levels of traffic input. The impacts of traffic data and various levels of data availability on pavement design will be demonstrated.

Poster Session

Long-Term Pavement Performance Monitoring of a Swiss Motorway

Lili Poulikakos

This project is unique in Switzerland, as it allows to monitor vehicle weight (WIM) and frequency, as well as the measurement of vertical pavement deformations caused by a vehicle at different pavement depths. In most cases, traffic monitoring equipment records only the number of vehicles on a particular highway section. There is still insufficient information regarding axle loads and their impact on the pavement to provide a basis for the development and optimization of pavement-dimensioning models. Such information is also required for the development of materials and new structural concepts.

Within the scope of rehabilitating the heavily traveled Swiss motorway A1 between Zürich and Bern, in 1998 a long-term in situ measurement system was installed to record amount and frequency of traffic loads, the numbers and type of vehicles as well as pavement temperatures and vertical deformations within the cross section of the pavement. The aim of the ongoing EMPA project is to collect and evaluate relevant data for improving the system properties and service life of roads.

The approximately 250 m long test section is located on the A1 motorway near Lenzburg between Zürich and Bern in Switzerland (Figure 1). The measurement systems were installed in 1998 on the lane towards Bern. The pavement consists of the following layers: Wearing course: 4 cm stone mastic SMA 11 S, Upper base course: 8 cm base course asphalt concrete HMT 22 H, Lower base course: 10 cm base course asphalt concrete HMT 32 H und Subbase: 10 cm subbase asphalt concrete HMF 22 S.

The monitoring of vehicle weight and frequency is conducted by a WIM (weight-in-motion) system that consists primarily of two load cells with piezoelectric quartz sensors. These sensors measure the weight and the axle loads of a passing vehicle. The data is collected by an on-site computer and transferred via modem for evaluation purposes. A single axle load of at least 6 tons triggers a special program to register the loads induced by the vehicle. From the characteristic load/time signal, the vehicle type is determined.

Joint Track – Session 9: Combined NATMEC/ICWIM Session

The CTWIM Suite

Rich Quinley

The CTWIM Suite is a collection of Windows based applications developed by the California Department of Transportation (Caltrans). These applications are designed to aid the Weigh-In-Motion (WIM) Analyst in performing tasks associated with the on-site calibration, acceptance and/or accuracy validation of WIM systems as well as the day-to-day monitoring of calibration of WIM systems from the office utilizing downloaded traffic stream data.

For on-site testing using one or more test trucks with known axle weights and axle spacings, statistical data is generated for comparison of actual "WIM vs. Static" results to accuracy requirements. Graphs can also be generated which display "WIM Error by Speed" plots for individual axles, axle groups, or gross weights. Such graphs can be used by the analyst in making decisions as to what system calibration parameter adjustments will produce the best estimate of static wheel weights for the most typical trucks in the traffic stream. Test truck WIM data can be hand entered or imported from the WIM system data files.

For analysis of the WIM truck traffic stream for system calibration accuracy, daily truck record data files (typically seven) are downloaded and imported into the program. Known operating characteristics of one or more specified truck classifications (typically Class 9) are then compared with traffic stream statistical summary data. Such summary data can be displayed in various distributions or graphic formats.

The CTWIM Suite is a flexible and powerful program designed for the dedicated analyst, not the "casual" user.

Track A – Session 12: 2002 Pavement Design Guide

Traffic Monitoring from the Illinois DOT's Perspective

Rob Robinson

The Illinois Department of Transportation (IDOT) has completed an ambitious program to collect 6,000 short-term classification counts on a two-year cycle. In accordance with the TMG recommendation of collecting more classification counts with fewer vehicles categories, IDOT now has complete system coverage of truck data on all 14,000 miles of marked routes throughout the State. The value to the States of the additional data required from the TMG and the upcoming 2002 Pavement Design Guide needs to be weighed against the high cost of installation and maintenance of classification ATR or continuous WIM sites. When the Pavement Design Guide is approved by AASHTO, each State will need the flexibility to calibrate the design criteria to conditions unique to their area. IDOT is utilizing length-based classification in three categories (PV, SU, and MU) with magnetic sensor Hi-Star traffic counters by NuMetrics. While more data is better from a research point of view, the need and usefulness of new data to the States must be thoughtfully considered before embarking on a large-scale data collection and management program.

TRACK A – SESSION 7: LTPP Specific Pavement Studies

A State's Perspective: Opportunities and Challenges

Richard B. Rogers

How important is traffic data to the Long Term Pavement Performance program (LTPP) effort? The answer to this question is the underlying reason for the LTPP effort. Since their inception, government highway agencies have contended that the level of traffic loads has a significant affect on the performance of pavements. Quantifying the affect of traffic loads on pavements was a priority at the American Association of State Highway Officials (AASHO) Road Test and is a priority for the LTPP effort. It is time to gain the support of our highway community, to acquire the resources for collecting the needed traffic load information. A brief overview of the opportunities that lie ahead will be provided.

Track B – SESSION 11: MPO Uses of Urban Traffic Monitoring Data

Applications of HPMS Data in Travel Demand Modeling at the Atlanta Regional Commission (ARC)

Guy Rousseau

Purpose, Problem and Issue: To ensure off-model travel is accounted for within regional estimates, EPA guidance requires HPMS-based forecasts of VMT for emissions analyses. Guidance requires that HPMS adjustments should be made, based upon a comparison of base year VMT from the transportation model to base year HPMS data. For areas with network-based travel demand models, such as Atlanta, a series of factors were developed to reconcile the network-based travel demand model estimates of VMT in the base year of its validation to the HPMS estimates for the same period. These factors were then applied to model estimates of future VMT.

Methodological Approach and Techniques: Atlanta's transportation models were validated using 1995 HPMS data. Emissions budgets for the 2003 attainment SIP were developed using 1997 HPMS estimates of VMT. To ensure consistency with the attainment SIP, ARC adjusted the modeled VMT upwards using factors calculated from the ratio of 1997 HPMS to 1997 modeled VMT to capture off-model travel volumes. A spreadsheet lookup function was applied to auto and truck VMT results to determine, based on the assignment group coded within the transportation network for the link, the appropriate HPMS adjustment factor needed to reconcile modeled VMT to HPMS estimates. Both the auto and truck VMT results are, therefore, still weighted by the ratio of 1997 HPMS to 1997 modeled VMT. This ensures that the forecasts are consistent with HPMS estimates. To calculate HPMS adjustment factors, an analog was developed to correlate the roadway classifications utilized by ARC in its transportation models and by GDOT (Georgia Department of Transportation) in its HPMS data specifications. A series of equivalency statements were developed to link Atlanta's roadway classification system to those used by GDOT, and as a result, four (4) adjustment factors were derived from those equivalencies. Because a transportation network was not created for the year 1997, a linear interpolation was applied to 1995 and 2000 modeled VMT to determine 1997 "modeled" VMT. One of the four adjustment factors, determined by the TRANPLAN assignment group classification (facility types) coded for each link in the transportation network, was applied to each link-based VMT result within the emissions model to calculate an HPMS-based forecast of VMT.

Conclusions, Findings and Lessons Learned: ARC realizes the need created by EPA for an HPMS-based forecast of VMT. In order to meet that need, ARC will revise and adopt new definitions of facility types, to be more in line with HPMS functional classifications. Currently ARC has ten (10) facility types (also referred to as TRANPLAN assignment groups), yet there are twelve (12) HPMS functional classes. ARC also plans on adding a field in its modeling database that would pertain specifically to HPMS functional class.

Track A – Session 4: Data Archiving

Michigan Database

David Schade and Mike Walimaki

The Michigan Department of Transportation (MDOT) has undergone efforts to re-host their traffic monitoring systems from the mainframe environment, rewrite archaic PC based processes, and develop new PC/PC network applications. Many of the applications such as data validation and editing, Annual Average Daily Traffic file maintenance, station location maintenance, etc. were developed using Foxpro. Along with the typical traffic monitoring data, Michigan's Intelligent Transportation System (ITS) data is also captured, transmitted to planning, and imported into the database for review. Once all of the traffic information is validated and accepted, it is loaded into the corporate database (Oracle). The corporate database is available to other MDOT applications, MDOT users utilizing ad-hoc-query tools, or through the use of MDOT's intranet traffic monitoring information web application. This session will focus on how Michigan has "set up" their traffic monitoring program, the software and databases, utilization of ITS data, and providing accessibility to the data.

Track C – Session 2: Congestion Management Systems: The Role of Travel and Traffic Data

CMS Data and Applications: Phoenix Metropolitan Area

Mark Schlappi

This paper presents an overview of CMS data applications in the Phoenix Metropolitan area. From 1998 through 2000 field data were collected as part of a regional congestion study for the Maricopa Association of Governments (MAG). A database with information from 2000 traffic counts and 50,000 aerial photographs of traffic was refined. This data was used to quantify the congestion on 190 miles of freeway and at 700 major intersections.

This information is being used in the MAG planning process as a base for regional studies, calibration of the MAG transportation models, and traffic engineering studies.

Track C – Session 6: Making the Connection Between ITS and Traffic Monitoring

Building a National Transportation INFOstructure: Recent Activities and its Impacts on the Traffic Monitoring Community

Rick Schuman

A significant policy debate occurring in the transportation/ITS community is whether or not a basic level of real-time monitoring capability – an "Infostructure" -- should be established along National Highway System (NHS) facilities. This presentation will describe types of data under consideration for collection by this Infostructure and how the Infostructure could be utilized by the traffic monitoring community.

Track B – Session 11: Management of Data Programs

Use of Urban Traffic Monitoring Data to Estimate LOS Defaults and Service Volumes

Terrell Shaw

This paper will demonstrate the usefulness of traffic monitoring data to estimate default values for generalized level of service (LOS) analysis and performance measurement and monitoring. The study involved the analysis of 3 years of continuous traffic monitoring data using Florida Telemetered Traffic Monitoring System (TTMS) which collects 15-minute data on speed, volume and classification at more than 350 sites statewide. This three year sample of data was used to classify and estimate important LOS default values including: ratio of peak hour to AADT (K) factors, directional distribution (D) factors, peak-hour factors (PHF), and percent of heavy vehicles (T) for 30th-highest hourly volume, 200th-highest hourly volume, and typical weekday peak periods. Several estimators were evaluated including median, mean and mode and distributions of the data were used to assess ranges and to stratify Florida's public roads into classifications suitable for generalized LOS analysis. Service volumes were then estimated using planning applications of the 2000 *Highway Capacity and Quality of Service Manual* and data was used to support Florida's Mobility Performance Measure Program.

Track B -- Session 3: Non-Traditional Data Sources

Video-Based Travel Time Information for a Rural Traveler Information System

Paul W. Shuldiner

The time required to complete a given journey is an important piece of information for making decisions respecting such aspects of the journey to work as mode, route and departure time. Where modal choice is restricted to the automobile for most trips and route options are limited, good travel time information respecting those few routes that are available is especially critical. This is the situation that pertains in the region of western Massachusetts where the University of Massachusetts Amherst is situated. Motivated by concerns over construction-related delays affecting the Coolidge Bridge, which connects the University on the east side of the Connecticut River with I-91 and the population centers on the west side, UMass, in cooperation with the Massachusetts Highway Department and the Federal Highway Administration, is in the process of creating a Rural Traveler Information Center (RTIC), an important element of which will be a travel time measuring system based on automated transcription of video license plate images. Travel time will be measured for both the Coolidge Bridge crossing and the nearest adjacent river crossing ten miles to the north. This information will be distributed to the public continuously on a real-time basis over the internet, and intermittently by other means. Webcam images of traffic conditions at key intersections and other critical points will also be made available on the RTIC website as a complement to the travel time information. In addition to describing the planned system in more detail, the presentation will address the challenges presented by the need to advise travelers not only of the current travel time for each alternative, but also of the travel time that will likely obtain on each alternative in the immediate future.

Track B – Session 4: State of the Art for Travel Time Data Collection and Analysis

The Virginia Smart Travel Van: A Traffic Data Collection System for the 21st Century

Brian L. Smith

The Smart Travel Van is a state-of-the-art mobile traffic data collection system. The van allows the Smart Travel Laboratory, an intelligent transportation systems (ITS) research facility of the University of Virginia and the Virginia Transportation Research Council, to collect highly detailed traffic data at any location – heavily traveled freeways, busy signalized intersections, work zones, or remote rural locations. In addition, the Smart Travel Van is a non-intrusive data collection device – it does not require placing or installing any equipment in travel lanes. The van's data collection capabilities complement the Smart Travel Laboratory's extensive permanent data collection locations (obtained via VDOT Smart Traffic Centers).

The Smart Travel Van was designed and integrated entirely by Smart Travel Laboratory students, staff, and faculty. In addition to its current configuration, the Smart Travel Van will serve as a platform for research and evaluation of new sensor technologies.

How It Works

The Smart Travel Van mobile traffic data collection system consists of 4 key subsystems: a telescoping mast, video detection system, computer, and the vehicle itself.

Telescoping Mast: A 42 foot telescoping mast is installed in the aft of the vehicle. The heavy-duty aluminum mast includes locking collars to ensure a solid foundation for sensors. The mast may be deployed at varying heights, and provides a platform for traffic sensors. Finally, an "aimer" unit is installed at the top of the mast to allow for positioning of the sensors.

Video Detection System: A commercial traffic video detection system is utilized for traffic data collection. This system consists of a camera, which is installed on top of the telescoping mast's aimer, and machine vision software. Once the camera is "pointed" at the desired location, the machine vision software is capable of detecting the presence and speed of vehicles at user-defined locations in the field of view.

Computer: The video detection system's software is installed on the Smart Travel Van's industrial, hardened computer system. The computer, installed in the van, will also be available for custom data collection and reduction applications developed by Smart Travel Laboratory students.

Vehicle: The vehicle platform for the Smart Travel Van is a V-10 cargo van customized for this application. The cargo portion of the van has been outfitted to include the telescoping mast, computer/electronics racks, and workspace for the operators of the van.

In addition, modifications include a hydraulic leveling system for stability during data collection, a gasoline-powered generator for electricity, and a complete power distribution system.

How the Van Supports Smart Travel Laboratory Research

Data collected by the Smart Travel Van includes traffic volumes, speed, occupancy/density, headways, limited classification, and video. This data will support on-going Smart Travel Laboratory research in the following categories:

- Traffic flow theory research
- Safety research (i.e. speed differentials, etc.)
- Evaluation/comparison of detector technologies
- Trip generation/traffic patterns (particularly at special events/planned incidents)

Track B – Session 3: Non-Traditional Data Sources

Anonymous Mobile Call Sampling: A New Approach to Traffic Monitoring

Brian L. Smith

A key function of intelligent transportation systems (ITS) is to provide transportation management services that improve the safety, efficiency, and reliability of surface transportation. In order to accomplish this, transportation management systems must estimate the state of traffic flow within the system. To do so, transportation management systems sample conditions throughout the transportation system using a variety of means, ranging from automatic sensors to verbal reports from travelers. Experience has shown that effective sensing of the state of the system in a cost-effective manner is quite difficult, and remains a fundamental issue facing the further development of ITS.

Anonymous mobile call sampling represents a new approach to traffic monitoring. In this approach, travelers using mobile phones are geolocated multiple times (sampled) as they make their journey. To ensure privacy, the travelers are sampled in an anonymous fashion. Given sufficient geolocation accuracy, and a sufficient number of sampled travelers, the system can conceptually provide a wealth of state information. In this research, the University of Virginia's Smart Travel Laboratory, in the Center for Transportation Studies, worked with a private firm to evaluate a prototype implementation of this approach in the Washington, D.C. area. Results from this effort, including sample size adequacy, speed estimation accuracy, and system availability, are presented.

Track A – Session 4: Data Archiving

Continuous Counter Inventory Service Calls Database

S. Frank Tabatabaee

The Florida Department of Transportation maintains a system of over 300 continuous traffic-monitoring sites on various Interstate, U.S. routes, and state highways around the state. At any particular time, around 10% of the sites are out of service due to road construction projects that may last from several months to several years, and another 5 – 10% of the sites fail to transmit their data files back to the office each night.

The Continuous Counter Inventory Service Calls Database and Application System was designed to track activities required to keep the continuous counters working and to account for the location of all pieces of equipment. This system enables users to initiate a service call for any particular site due to equipment failure, road construction or routine maintenance. The dates of when problem was first reported, when the site was visited, and when the problem was fixed is recorded for each service call. There are also codes used to describe the initial symptom, the actual problem(s), and corrective action(s), as well as a verbal description of what the technician found and fixed.

Often, a malfunctioning piece of equipment is replaced with another piece of equipment. In order to simplify our annual inventory of equipment, the service call database automatically updates the date a particular piece of equipment was last seen with the completion date of a service call. If the equipment is swapped, its location is also automatically updated. Only equipment that has not been seen in the last year need be physically inventoried.

The date contained in the Service Call database will also allow us to determine whether a particular counter type or a specific piece of equipment frequently exhibits a certain type of problem. Once a recurring problem has been noted, corrective action can then be taken to prevent future problems of this type.

Track A - Session 3: Non-Traditional Sensors

The Michigan Experience with Utilizing Fiber Optic Sensor Technology

William H. Tansil

The results from the State of Michigan using fiber optic sensor technology:

The sensors were installed as part of an"in-house" study to evaluate the accuracy, reliability, and survivability of various types of data collection equipment. The State of Michigan is very interested in innovative methods to collect volumes, classification, and weights on various types of highways and under a variety of conditions. Traffic data was collected during twenty different field testing sessions under actual roadway conditions. The sessions were performed with the cooperation of the Michigan State Police as well as the Michigan Department of Transportation's regional office.

Track C – Session 12: GIS and Web Tools to Organize Urban Traffic Data

Applying Today's Technology to Traditional Transportation Projects

Steve T. Taylor

Advances in technology have provided new techniques to improve the quality and quantity of information for many transportation projects, including congestion management studies. Among these techniques are the use of digital video, Global Positioning Systems (GPS), and Geographic Information Systems (GIS). Digital video is used to inventory roadways and provides a continuous visual assessment of a corridor with GPS coding in one run. GPS equipment installed in a vehicle (ground or air) marks the location of the vehicle at regular intervals and time-stamps the data. The raw data can be manipulated to produce travel time and speed information for specific locations or as an average over specified segments of a corridor, and viewed and interpreted using GIS. Data for specific locations or segments can be color-coded by user-defined levels. Clicking on a point along a corridor will start the digital video on that roadway and at that point. This information assists in determining specific problems and possible improvements, such as as signal timing, to provide immediate relief to a corridor without requiring expensive widening projects. The digital video and GPS data can also be used for other projects. Linking this information within GIS results in a powerful and efficient methodology for performing otherwise time-consuming studies.

Track B – Session 8: Integration of Data Sources

Data Integration for Asset Management - A Canadian Perspective

Michael Trickey

Synopsis

Perhaps the most fascinating thing about Asset Management is its multitude of definitions and the lack of specific details, which, in reality, are required and must be accepted to give life to this strategic business concept.

"Never neglect details…Strategy equals execution. All the great ideas and visions in the World are worthless if they can't be implemented rapidly and efficiently."
(Colin Powell, Chairman (Ret.), Joint Chiefs of Staff)

Asset Management is the catalyst that enables us to management knowledge and information to make efficient short and long-term business decisions:

- Is a business culture;
- Is not a system, but an encompassing process made up of sub-processes and analytical tools that facilitate the identification, implementation and management transportation investments in a repeatable and auditable fashion;
- Integrates priorities, direction & decisions across & within organizational divisions, across & within functional business units, across & within asset categories;
- Provides customers with the greatest outcomes through investments by integrating technical, economic, financial and business processes & techniques; and
- Promotes a team and creative work environment.

Tools are the most recognizable features of Asset Management, they are tangible, they can be seen, touched and manipulated (pavement system, bridge system, etc). These are typically developed in isolation of one another within their functional units. Consequently there is little hope for integration without renewal or upgrading under asset management to:

- Remove data, information and structural redundancies;
- Incorporate common geo-referencing;
- Accommodate common planning horizons and analysis variables;
- Produce new wave asset management outputs; and
- Share data and information; and
- Ensure the right information at the right time.

Asset Management therefore must also look data & information from a business perspective, as investments, and manage accordingly. This requires changes, champions, a single business focus, an ongoing program of funded needs, and service level agreements or contracts with IT business units.

Track A – Session 2: Traditional Sensors

Sensor Sharing Among Applications

Robert Triplett and Joe Avis

This presentation addresses the development and use of a device to allow Automatic Traffic Recorders (ATR) that detect electronic switch closures to safely read the outputs of detectors installed in traffic signals, ramp meters and Traffic Management Center applications. This device is the Detector Isolation Assembly (DIA). The DIA has 30 independent channels and each input is optically isolated from each output channel. It's main purpose is to guarantee that the ATR equipment will not affect the logic signals from the detector sensor units to the controller unit. The cost benefit of allowing the ATR equipment to use the existing sensor elements, detectors and controller cabinets is obvious.

This presentation will include the following:

1. The origin of the DIA
2. Design of the DIA
3. Illustrate Caltrans application of the DIA

Track C – Session 6: Making the Connection Between ITS and Traffic Monitoring

Making the Operations to Planning Connection in Texas: Experiences and Findings

Shawn Turner

This presentation will highlight recent operations data archiving/sharing activities and experiences in Texas. Several studies have been completed and preliminary data archiving efforts are underway in several urban areas. For example, Houston TranStar is currently developing a data warehouse that will provide access to high priority operations data. TranStar is also working with local TxDOT planners to determine optimum locations for future TranStar sensors. The North Central Texas Council of Governments (NCTCOG) is planning to develop a data warehouse that will be utilized by numerous agencies in the Dallas-Ft. Worth area. NCTCOG also plans to use the recently established center-to-center data and protocol standards to retrieve operations data from TxDOT and other operations groups in the area. TTI is working with TxDOT staff in Austin in improving their data archives and making it available to the local and statewide planning community. TTI is providing technical assistance in using the data for basic traffic monitoring and congestion management applications.

Track B – Session 7: Integration of Data Sources

Summary of TRB Peer Exchange on Data Integration

Anita Vandervalk

The topic of transportation data integration is becoming very important for transportation agencies. As governmental agencies become more accountable to the public, performance based planning and asset management programs are becoming more prevalent and the data needs associated with these programs are enormous. Compiling data from a variety of sources is critical to the success of both data collection and policy planning programs.

The TRB Statewide Data Committee (A1D09) held a peer exchange March 22 and 23, 2001 to address this very interesting and timely topic. The peer exchange participants shared ideas and experiences on data integration and developed several guiding principles and success factors. This presentation will summarize the discussion items and results of the exchange.

Track C – Session 12: GIS and Web Tools to Organize Urban Traffic Data

The Houston TranStar Traveler Information Web Site

Michael J. Vickich

The Houston TranStar Traveler Information Web Site (http://traffic.tamu.edu) provides the public with a wide variety of traffic information for the greater Houston area. The site was developed by the Texas Department of Transportation (TxDOT) and is operated as a part of the Greater Houston Transportation and Emergency Management Center, known as Houston TranStar.

Since it's inception in 1994, the web site has evolved into an extensive traveler information system. TranStar's Intelligent Transportation Systems (ITS) deployed services such as Automatic Vehicle Identification (AVI) sensors and Closed Circuit Television (CCTV) cameras act as the data source for the system. Using the data from these resources, the web site is able to feature real-time and historical travel-time data and maps, speed charts, incident information, road closure information, and snapshots from roadway cameras. The web site is widely used by the public, and transportation and emergency management personnel at Houston TranStar, with approximately 90,000 different users accessing the system each month.

Organizing the web site to provide users with a variety of traffic information requires several design criteria to be addressed including accuracy, timeliness, reliability, and presentation of the information disseminated.

This presentation summarizes the features of the web site and addresses the challenges of packaging and disseminating urban traffic information in a useful format via the Internet.

Track A – Session 11: Weigh In Motion

Alternative Methods for Estimating ESALs

Herbert Weinblatt

Data from 55 permanent WIM sites in California were used to evaluate alternative methods for estimating average ESALs per vehicle on roads that are not routinely monitored. It was found that substantially better estimates can be obtained by using short-duration data collected on a road of interest than by using default values obtained from permanent WIM sties on roads belonging to the same functional system or in the same region. Ignoring calibration and equipment errors, the former approach typically produces mean absolute percentage errors (MAPEs) of about 8 percent, while the latter approach produces MAPEs of about 22 percent.

Track A – Session 12: 2002 Pavement Design Guide

Traffic Data Collection and Analysis for Pavement Design

Herbert Weinblatt

The 2002 Guide for the Design of New and Rehabilitated Pavement structures allows users to provide the software with various “levels” of traffic data. These levels, which are generally based on principles and recommendations presented in the 2001 Traffic Monitoring Guide, are described. Increasing the quality (or “level”) of the traffic data used will result in appreciable reductions in cost and/or increases in reliability of the resulting pavement designs produced by either the 2002 Guide or by current pavement design procedures.

Track B – Session 2: Privatizing Traffic Monitoring Programs

Public/Private Partnerships: A Data Collection Team That Works

Todd B. Westhuis

The New York State Department of Transportation has successfully partnered with three firms, International Road Dynamics, Planert Utility and ERES Consultants, to expand the NYSDOT traffic monitoring continuous count system of 93 sites by constructing 63 additional continuous count stations. The initiative also included contracting for the operation and maintenance of the existing and new continuous count stations. The firms provide both construction and management (operations and maintenance) of all sites, with maintenance payments based on quality and quantity of data provided to NYSDOT. The firms have successfully completed the site installations as well as assumed operations and maintenance duties for all existing sites in all three contract 'zones'. The system readiness is consistently above 95% overall with all necessary data routinely being provided to NYSDOT in a timely manner. NYSDOT's own polling operations and reporting have been significantly enhanced with additional software and standard operating procedures developed as part of this initiative.

Track A – Session 6: Quality Control of Data

Automating Class and Volume Editing with the Pennsylvania Traffic Editing Program

Dennis Williams

Beginning in late 1994, Pennsylvania began design and implementation of a mainframe-based automated volume editing process. A review of traffic systems was conducted in 2000. In this review, it was decided to implement this process in a PC-based application.

In August 2000, the Bureau of Planning and Research partnered with a consulting firm to develop PC-based traffic volume and class editing system. Initial requirements called for the system to incorporate the existing system's methodology and use ideas from other sources. An in-house team was formed to set specific parameters, guide project development, and expand upon the limitations of the existing system.

The resulting system, called the Traffic Editing Program (TEP), imports data in FHWA-standard record formats. It provides flexible automatic edits based on comparisons with historical counts and averages. The user may review and edit counts in tabular and graphical form, and can edit class data at various levels of aggregation. TEP produces a variety of reports in Hypertext Markup Language (HTML) format. It exports edited data in FHWA standard record formats. TEP was written in Visual Basic, and stores data in Microsoft Access databases.

The success of TEP was far beyond the original expectations of the project. It generated the interest that resulted a follow-on project, whose goal is to develop a comprehensive "Traffic Information System". This system will include functions for field operations management, daily assessment of downloaded counts, analysis of short-term counts and ad hoc reports.

Poster Session

Pennsylvania Department of Transportation Traffic Information System

Dennis Williams

A timeline showing the evolution of the Traffic Information System as developed by the Bureau of Planning and Research, Transportation Planning Division.

Track A - Session 8: Automatic Traffic Recorder Fundamentals

Traffic Monitoring Using Solar Power

William Wilson and William Young

Florida's abundance of sunshine can be used to power traffic devices and reducing energy cost. The Florida Department of Transportation (FDOT) and Florida Solar Energy Center (FSEC) have studied and demonstrated many photovoltaic (solar electric) applications to power various traffic devices. Message signs, flashing arrow board, flashing warning signals, highway signs, and traffic monitors are some of the traffic devices on mobile units or at remote site that require electricity. There are many factors to consider in the design and installation of a PV powered traffic device.

The successful application of photovoltaics to power a traffic monitoring device requires the proper understanding of PV design criteria and the art of applying solar energy. As an example: seasons have an effect on the amount of energy product from the sun, which need to match times of critical operation. Also, orientation of the device and PV array affect energy production as well as location. Understanding the load and the operating characteristics of the device are also needed to design and size the PV array properly. Meeting codes and standards are important for safe and reliable systems. This paper will detail procedures, design criteria, and practices for viable, cost-effective and safe PV powered monitoring equipment.

Track C – Session 11: Innovative Uses and Applications of ITS/Operations Data Archives

Using Archived Data in the Validation of Travel Time Predictions

Robert Winick

This will report on the status of the work being performed for Maricopa County and AZTech in the Phoenix area to develop techniques for estimating predictive travel times that can be displayed on Variable Message Signs. Archived data associated with I-17 from Dunlap to Buckeye is to be used in comparing different estimates of travel time for a trial period of time including: (1) snap-shot travel times, (2) after-the-fact travel times, (3) probe-travel times, and (4) predicted travel times using a prediction algorithm. Archived data will be used both in calibrating the prediction algorithms as well as in conducting validation tests of trial predictions.

Track A – Session 7: LTPP Specific Pavement Studies

LTPP SPS Traffic Pooled Fund Study

Larry J. Wiser

The Long Term Pavement Performance (LTPP) Specific Pavements Study (SPS) Traffic Data Collection Pooled Fund Project TPF-5(004) study is designed as a mechanism for highway agencies to improve the collection of monitored traffic data for five of the LTPP Specific Pavement Study (SPS) experiments. A 1998 review of the LTPP data concluded that the spatial distribution, timeliness, quantity, and quality of the monitored traffic data must be improved to ensure the success of the SPS-1, -2, -5, -6, and –8 experiments. It is estimated that at least half of these SPS sites do not have the quantity and quality of traffic data that is needed for analysis. Twenty-two of the 37 States with SPS-1, -2, -5, -6, and –8 sites have expressed interest in participating in the pooled-fund study. Use of 100 percent State Planning and Research funds for all of the study's activities has been authorized to promote participation by every highway agency. The pooled fund study offers a unique opportunity for the States to participate in an effort to significantly advance the state of the practice of collecting and processing traffic load data to support pavement performance analysis. The Project sites being studied may be used to support other needs, such as: the 2002 Pavement Design; the FHWA Highway Performance Monitoring System; FHWA Truck Weight Studies; and State Highway Agency pavement designs and Pavement Management Systems.

Track A – Session 7: LTPP Specific Pavement Studies

Pre-Proposal Conference - LTPP WIM Assessment, Calibration and Performance Evaluation Contract

Larry J. Wiser, Richard B. Rogers, and Amy L. Kruger

Presentations will be made on the general and technical issues of request for proposal (RFP) DTFH61-02-R-00041, "Assessment, Calibration and Performance Evaluation of Weigh-In-Motion Sites." The assessment, calibration and performance evaluation of WIM systems at the Specific Pavement Studies (SPS) sites in a consistent manner across the nation will require an in-depth knowledge of the various WIM systems being used by the states and considerable resources not readily available to the FHWA. Therefore, it is necessary to obtain the services of a contractor to supply the resources and the technical expertise needed to verify and document that the various WIM systems are operating at peak performance and, if not, diagnose the problem and identify the corrective action needed. Accordingly, the FHWA anticipates releasing RFP DTFH61-02-R-00041 on or around May 1, 2002 with proposal due approximately 30 – 45 days after RFP release. This solicitation will be released and available electronically at http://www.fedbizopps.gov. Potential offerors are encouraged to attend the subject presentation to learn more about the technical and proposal requirements. A room has been reserved to continue discussions if additional time is needed.

Track B Session 4: State of the Art for Travel Time Data Collection and Analysis

Video-based Travel Time Data Collection & Analysis for the Metrolina Region External Travel Survey

Jeffrey B. Woodson

Video-based license plate surveys have been used to collect and analyze travel time data in transportation planning applications for many years. This report describes this methodology as it applies to collecting and analyzing large amounts of travel time data as a part of the Metrolina Region External Travel Survey. In a single 12-hour day, 43 high specification video camcorders were employed over 43 lanes of traffic in and around the metropolitan area of Charlotte, North Carolina to collect approximately 400,000 vehicle license plates traveling through the region. Subsequent automatic analysis and matching of these license plates yielded, both accurate origin-destination patterns and travel time and average speed data between all camera locations. Travel time data was analyzed and reported separately for passenger and commercial vehicles. *Transfo* worked in collaboration with the Louis Berger Group, the Titan Atlantic Group, Mandala Services, Inc. and Carolina Public Relations in the conduct of this survey for the North Carolina DOT, South Carolina DOT and the City of Charlotte DOT in July 2001.

Track B – Session 8: Integration of Data Sources

Future of Data Integration: Combine Remote Sensing Data and Ground Truth Data

Demin Xiong, Anita Vandervalk, and Rodney Floyd

With increasing availability, higher resolution and lower price, remotely sensed data becomes an important information source for many types of transportation applications. This presentation provides an overview of the potential of integrating remote sensing with ground based systems, including Geographic Information Systems (GIS), Global Positioning Systems (GPS) and Mobile Mapping Systems (MMS), for the monitoring, evaluation and management of transportation systems.

Track B – Session 7: Integration of Data Sources

Integrating Traditional and Non-Traditional Data Sources: The GCM Gateway Traveler Information System

David Zavattero and Syd Bowcott

As one of the four priority corridors originally established by the US Congress under the ISTEA legislation, the Gary-Chicago-Milwaukee (GCM) Corridor has been the scene of numerous ITS projects. One of the largest and most complex is the Gateway Traveler Information System (TIS) which is being led by the Illinois Department of Transportation (IDOT). The Gateway involves the collection of transportation related data within a three state area and distribution of this data back to the sources as well as to the public and information service providers. It also includes provision for joint control of field devices across jurisdictional boundaries. While the Gateway interfaces with traditional traffic data sources such as traffic management centers, it also interfaces with non-traditional/non standard sources such as 911 centers and weather sensors. A large part of the Gateway project has focused not only on identifying the useable data such sources could provide but also on identifying the data that the Gateway could provide to them and developing the process for sharing this data. Issues that had to be addressed included data filtering and development of new institutional arrangements with agency staff that were unfamiliar with ITS. Thus far the sources that have been successfully interfaced include Northwest Central Dispatch (regional 911 center), the Illinois State Police, and IDOT's weather detectors. Discussions are currently underway with Chicago 911 and the Chicago Transit Authority to integrate data from these sources into the Gateway.

This paper documents the process that took place during the development and implementation of a three-state traveler information system. During this development, significant issues needed to be addressed to interface non-traditional/non standard data sources. Some of these issues were technical in nature, while others were institutional. Many of these issues will also need to be addressed by other systems in the US.

Poster Session

Measurements on short slab Bridges without Axle Detectors

Ales Znidaric

Free-of-Axle Detector (FAD) concept has been introduced to the bridge weigh-in-motion (B-WIM) systems within the European Commission's 4th Framework research project 'WAVE - Weighing-in-motion of Axles and Vehicles for Europe', where the theoretical backgrounds have been developed. The main idea behind the research was to improve durability of weigh-in-motion systems by avoiding the only measuring component, which is directly exposed to traffic and thus being prone to deterioration. The further objectives of the FAD development were to reduce traffic delays and costs associated with installation and maintenance of the WIM systems and to contribute to the traffic safety. By removing all visible objects from the road surface, the overloaded truck drivers would also have difficulties to escape the traffic control. When implemented, the FAD approach:- will considerably facilitate the bridge WIM system installation and maintenance,- will not require any road closures during the exploitation, which is extremely important on very busy roads, and-will enable portable WIM data collections even in snowy conditions when WIM measurements are very unreliable due to the snow ploughs presenting constant danger to anything placed on the surface of the road.

Studies showed that the new approach is applicable to orthotropic deck bridges and to short slab bridges. During the WAVE project, an orthotropic deck bridge and two short slab bridges have been examined. As information was acquired only from the strain sensors attached to the superstructure, a considerably more complex data processing was applied. Positive experiences from WAVE resulted in extensive further research on short slab bridges and several additional bridges in Slovenia and in Sweden have been tested. They included simply supported and integral underpasses with single spans of less then 10 m and a structure composed of two 3-m long spans. Results show that successful FAD measurements require adequate selection of the bridge, optimal installation of strain transducers and properly performed calibration of the structure. Compared to the axle detector installations, slightly lower accuracy of the weighing results can be expected as a result of less precise measurements of the vehicle velocity. The accuracy nevertheless remains fully comparable to that achieved with other types of WIM systems and thus sufficient for most applications dealing with traffic loading data.